A collaborative research lab supported by the USFS Pacific Northwest Research Station and OSU College of Forestry

LARSE

Laboratory for Applications of Remote Sensing in Ecology

Current Research

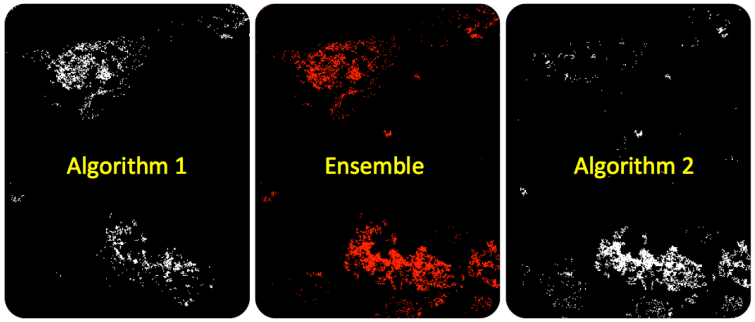
Warren B. Cohen's Research Team & Extended Science Family

23 July 2014

Landsat Science Team Meeting, Corvallis, OR

Current LARSE Research

1. LCMS (Landscape Change Monitoring System)
   - National, inter-agency program for monitoring vegetation change driven by *Landsat time series*
   - Science Leads: Healey, Cohen, Yang, Loveland
   - Features
     - All lands, all veg types, all pixels
     - Integrate change products from the Algorithm Giants
       - Kennedy, Woodcock, Zhu, Vogelmann, Steinwand, Huang, Hansen, Moisen+, Healey+, ++



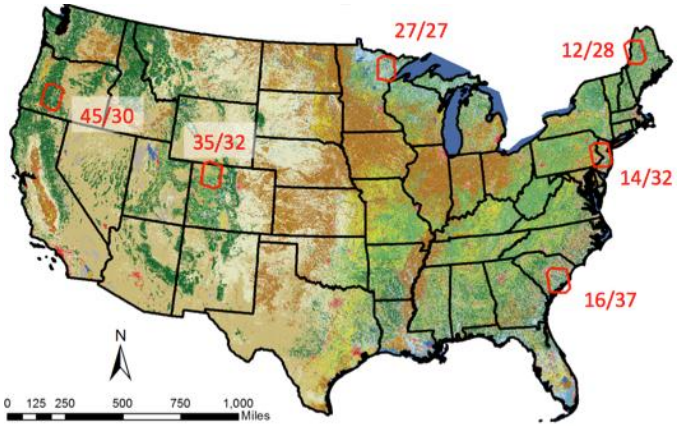
Small section of Landsat scene showing disturbance as mapped by the two base learners and as mapped via an ensemble model.

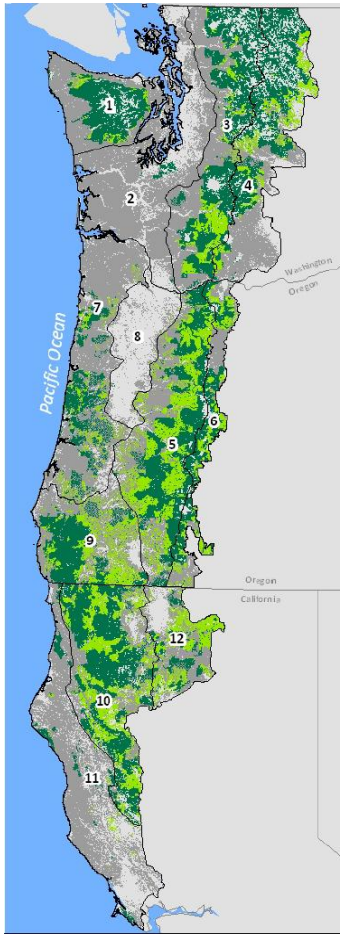
     - Stats guru: Honorable Dr. Stehman
     - Train with causal agent data
     - Derive independent disturbance estimates with TimeSync
     - Tweak model coefficients for input maps to match estimates

Dr. Steve

LCMS (Landscape Change Monitoring System)

- Pilot studies
  - Proof of Concept
    - Six WRS PRs
    - Discovery
    - *e*Integration
  - NWFP Implementation (includes Gregory, Ohmann, Roberts, Bell)
    - Next phase of ongoing LARSE (+LEMMA) project using Landsat change detection to inform models for vegetation mapping through time
    - Management and policy implications

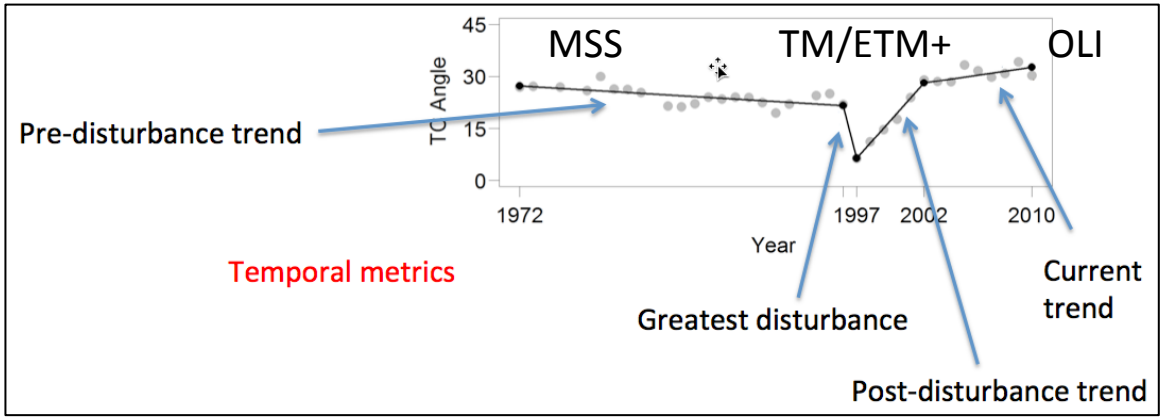


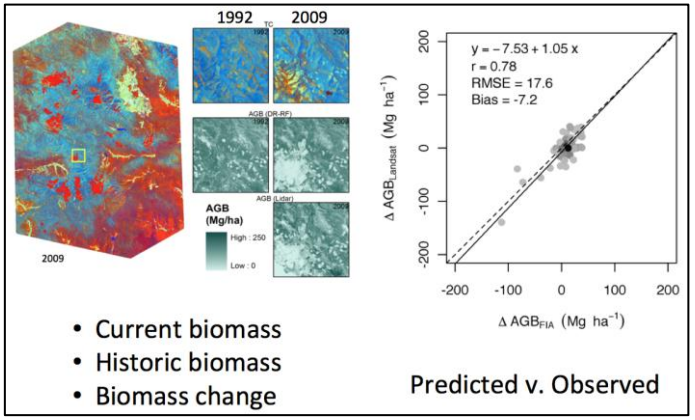


Current LARSE Research

2. Historically Consistent and Broadly Applicable MRV System Based on Lidar Sampling and Landsat Time-series (NASA Carbon Monitoring System) – six LCMS scenes

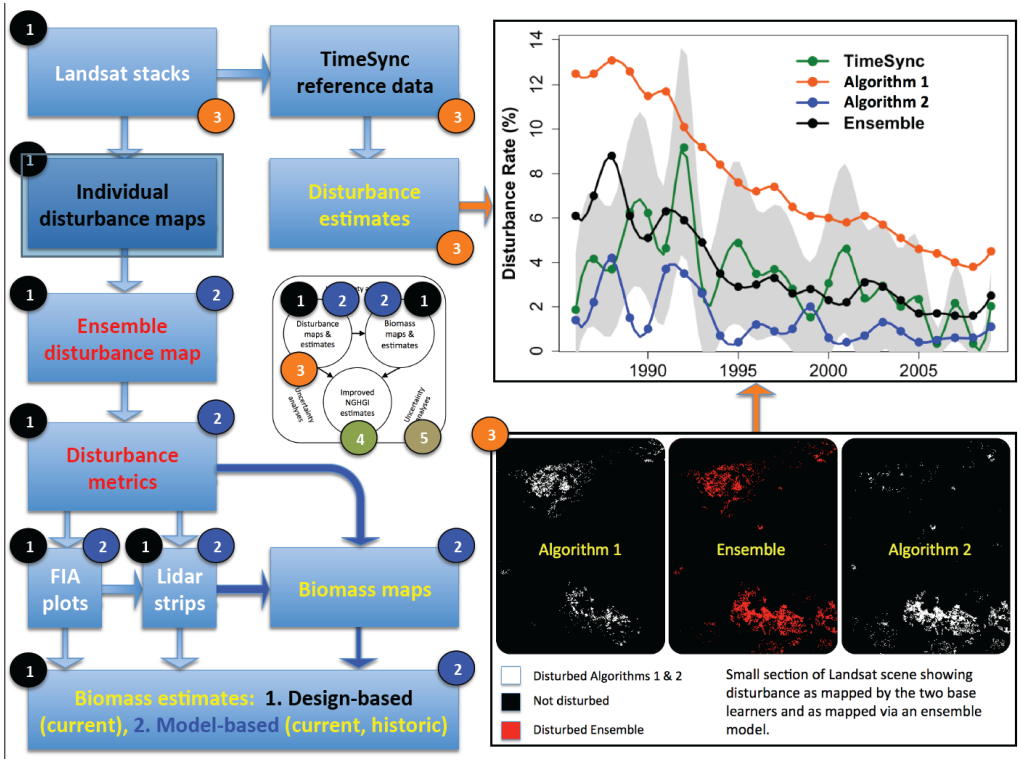
- Team
  - Cohen, Andersen, Healey, Moisen, Schroeder, Woodall, Domke, Yang, Stehman, Kennedy, Woodcock, Zhu, Vogelmann, Steinwand, Huang
- Objectives
  - *1 & 2. Create **current & historic** aboveground live biomass maps and estimates* that integrate a selection of spatially- and temporally-coincident FIA plots, lidar samples, and Landsat imagery, with Landsat-derived disturbance history metrics





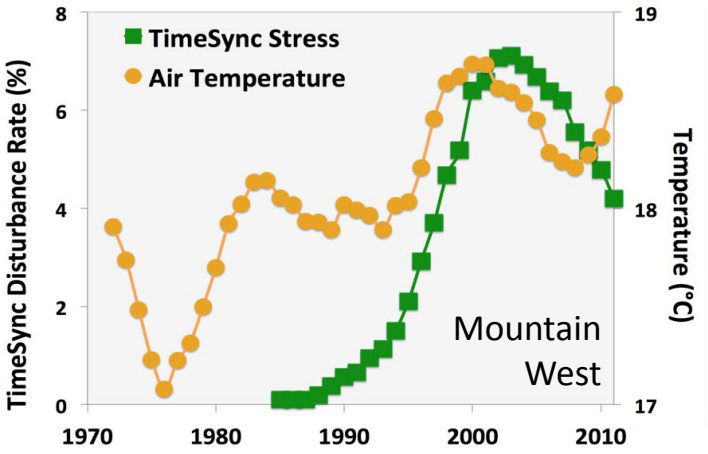
Historically Consistent and Broadly Applicable MRV System Based on Lidar Sampling and Landsat Time-series

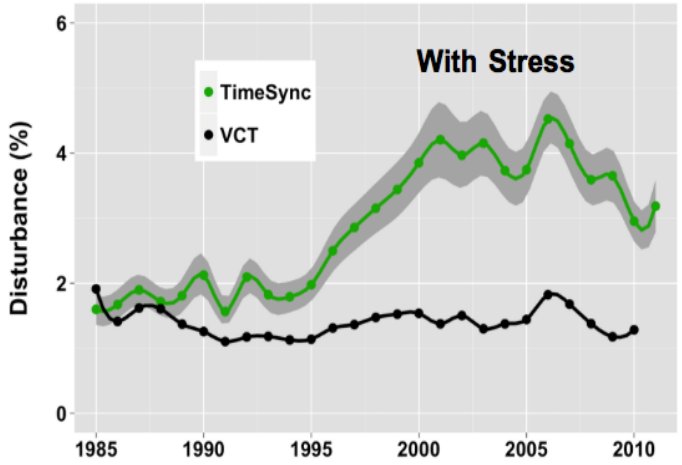
- Objectives, cont…
  - *3. Improve the existing US NGHGI approach to estimate live biomass consistently through time* for each year from the current period back to 1990
- Features
  - Use history metrics to inform biomass estimates; walk back in time – requires MSS data
  - Metrics derived from ensemble maps
  - Estimate uncertainty in both model-based and design-based inference frameworks
  - Examine trade-offs among different formulations of data and models to inform REDD



Current LARSE Research

3. North American Forest Dynamics (NAFD)
   - NASA funded for NACP: Goward, PI
     - Disturbance mapping (VCT, Goward/Huang team)
     - QA and independent estimation (TimeSync, Cohen team)
     - Disturbance causal agent (Moisen team)
     - Recovery trajectories (Masek team)
     - Wrapping up 12+ years of effort



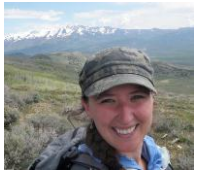


Current LARSE Research

4. Student projects (all with strong field component)
   - Describing the effects of state and national policy change on US wetlands (Fickas)
     - Multiple US locations, Landsat time series 1972-present

   - Using phenology as an indicator of growth trajectories in early successional forests (Briggs)
     - HJA Andrews Experimental Forest area, integrate Landsat and MODIS

   - Modeling cavity nesting bird habitat as a function of post-fire forest structure (Vogeler)
     - Central OR Cascades, lidar & Landsat time series



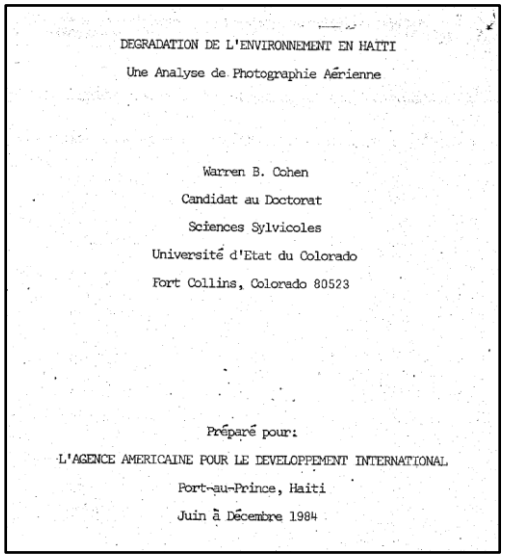
   - Insect effects on tree mortality, fuels, and wildfires (Meigs – REK)
     - PNW Region, LandTrendr, IDS, fire data

Current LARSE Research

5. Three featured projects
   - Locating the remaining original, native forests in Haiti to help preserve biodiversity (~~Yang~~ Cohen)
     - Landsat time series (~1972-present)
   - Causes and consequences of increased insect and disease activity in the western US (Braaten)
     - Landsat time series (1972-present), climate, related data
   - Characterizing forest stress and vulnerability in the PNW region (Mildrexler)
     - Indices derived from MODIS & climate data; corroborate with Landsat time series

Original Forests of Haiti

- Deforestation in Haiti is well documented, with anecdotal estimates of original, native forest as low as 1%
- In recent years reports of forest cover increasing, but much of the new forest cover is non-native, often invasive
- Native animal biodiversity not adapted to new forests and remain under great stress
- To document remaining animal biodiversity and broadcast the threat of its extinction, we need to know where the original, native forest are



DEGRADATION DE L'ENVIRONNEMENT EN HAITI

Une Analyse de Photographie Aérienne

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Préparé pour:
L'AGENCE AMERICAINE POUR LE DEVELOPPEMENT INTERNATIONAL
Port-au-Prince, Haiti
Juin à Décembre 1984

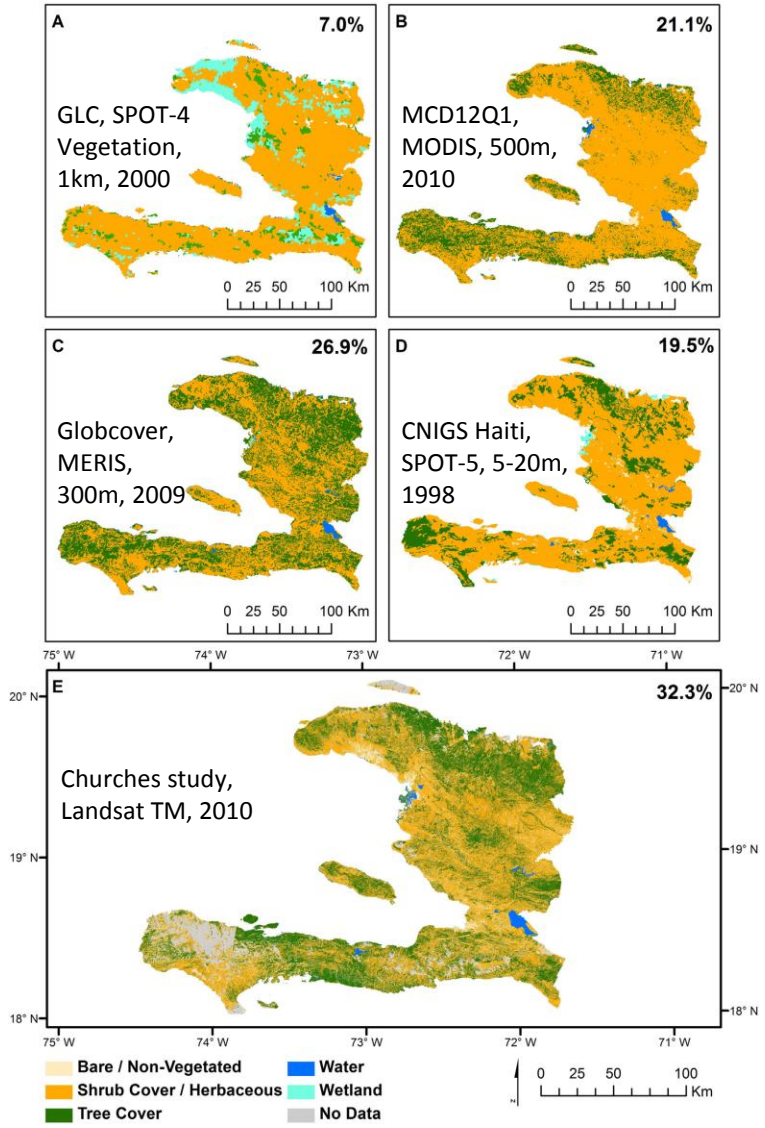
Collaborating with Blair Hedges, Penn State Unive and Joel Timian, Société Audubon Haiti

CLICK IMAGE for trailer on our work in Haiti. 1-hour movie showing at film festivals (2014)

Where Are The Original, Native Forests?

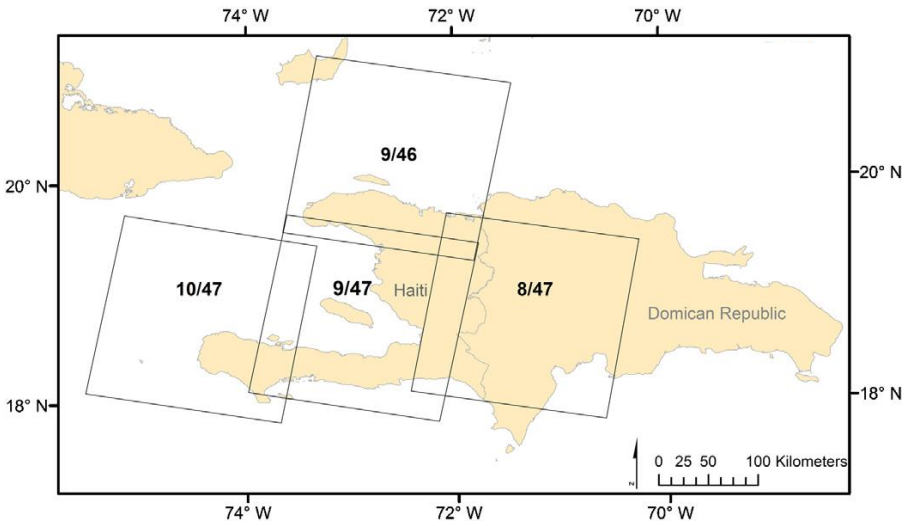
- Recent study compared existing maps of Haiti forest cover derived from a variety of satellite sensors and approaches
  - All based on a relatively static view of tree/forest cover
  - Results indicate range from 7% to 32%
  - Little known about the CNIGS dataset, but generally…as spatial resolution increases, more forest appears
- From all there is no way to distinguish long-term, stable forest cover from new, less diverse and commonly non-native forest cover

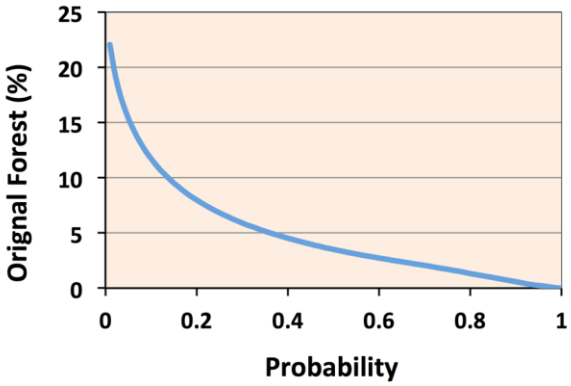
From Churches et al. 2014, Int J Applied EO & GeoInf



A Landsat Time Series Approach

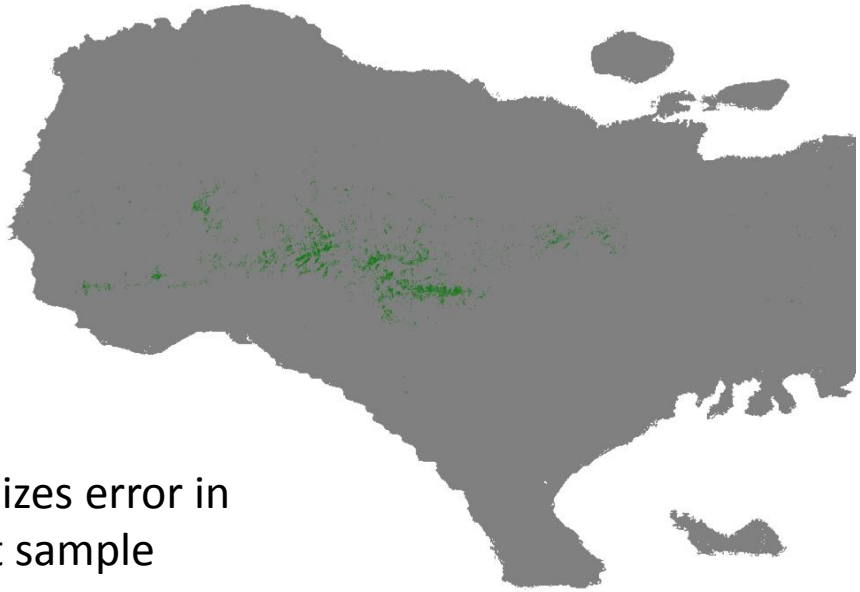
- Started with 10/47 (highest biodiversity value); collected sample-based training data using Google Earth as guide
  - Closed forest (class of interest), open forest, non-forest (noted GE dates)
- Created cloud-free maxNDVI annual composites (1973-2013)
- Match training data to time series
- Random forest model for each year to derive pixel-level *p* (closed forest)
- Temporal-weighted consistently closed forest, *p* (most likely original, native)
- Likely original, native forest cover =





- 22.5%, *p* (0.01)
- 3.5%, *p* (0.50)
- 1.7%, *p* (0.75)

Find *p* that minimizes error in independent, test sample



MSS, ETM+, OLI

- For annual maxNDVI composites, how do MSS, ETM+, and OLI compare in terms of mapping the three basic classes?

- By extending back to 1973 we increased the confidence that we are mapping our target population

1979

MSS	Closed Forest	Degraded Forest	Other	OOB Error
Closed Forest	1163	133	2	0.104
Degraded Forest	54	2897	32	0.029
Other	0	26	3105	0.001

2013

TM/ETM+	Closed Forest	Degraded Forest	Other	OOB Error
Closed Forest	1198	79	4	0.065
Degraded Forest	58	1610	73	0.075
Other	2	90	1163	0.073

2013 & 2014

OLI	Closed Forest	Degraded Forest	Other	OOB Error
Closed Forest	392	68	1	0.15
Degraded Forest	13	1805	81	0.049
Other	3	118	1413	0.079